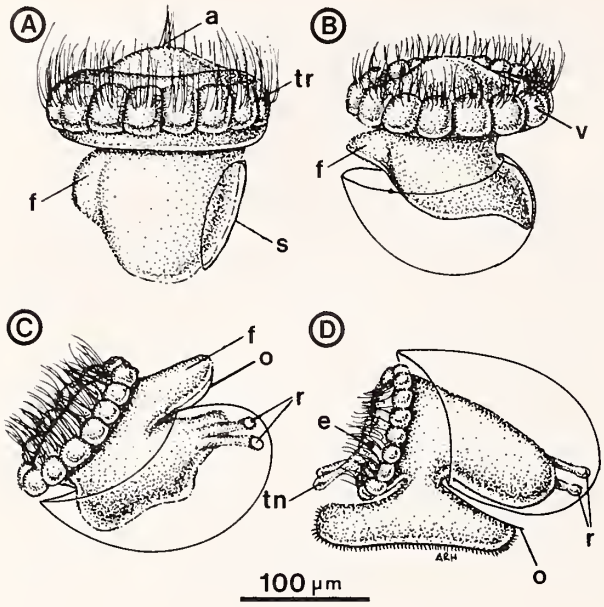


Figure 1

Developmental stages of *Lottia digitalis*. A. Late trochophore stage: a, apical tuft of cilia; tr, trochal band of cilia; f, foot rudiment; s, shell. B. Pre-torsional veliger: f, foot; v, velum. C. Post-torsional veliger: f, foot; o, operculum; r, retractor muscles. D. Crawling veliger in mid-metamorphosis: e, eye spot; tn, tentacles; r, retractor muscles; o, operculum.

al. (1996), provide the most complete description of larval development for this species to date. The two studies also show that the timing and pattern of *L. digitalis* development is similar to that of other patellogastropods of the region (Strathmann, 1989), and that a portion of San Juan *L. digitalis* populations readily spawn in the laboratory during the winter.

Those characteristics make *L. digitalis* a good research organism for studying the development and larval ecology of mollusks with lecithotrophic development, regardless of time of year. Further studies are needed in order to determine whether San Juan Island *L. digitalis* spawns in the field during the winter, since *L. digitalis* reportedly spawns in the field in the San Juan Islands only during spring and summer months (Strathmann, 1987).

Literature Cited

Chia, F. S. & R. Koss. 1978. Development and metamorphosis of the planktotrophic larvae of *Rostanga pulchra* (Mollusca: Nudibranchia). Marine Biology 46:109–119.

Koppen, C. L., J. R. Glascock & A. R. Holyoak. 1996. Spawning and larval development of the ribbed limpet, *Lottia digitalis* (Rathke 1833). The Veliger 39:241–243.

Ricketts, E. F, J. Calvin, J. W. Hedgpeth & D. W. Phillips. 1985. Between Pacific Tides. 5th ed. Stanford University Press: Stanford, California. 652 pp.

Strathmann, M. F. 1987. Reproduction and Development of Marine Invertebrates of the Northern Pacific Coast. University of Washington Press: Seattle. 670 pp.

The Description of a New Species of *Favartia* (*Murexiella*) from the South Pacific Ocean

Barbara W. Myers[1] and Carole M. Hertz[2]
Associates, Santa Barbara Museum of Natural History,
2559 Puesta del Sol Road, Santa Barbara,
California 93105, USA

Introduction

Dr. Donald R. Shasky of Oceanside, California, made available to us for study some specimens of a muricid he collected offshore at Pointe Taharaa, Papara and Motu Martin, all Tahiti, Society Islands. We have determined them to be an undescribed *Favartia* (*Murexiella*) species.

There has been considerable difference of opinion in recent years concerning the placement of *Favartia* Jousseaume, 1880, and *Murexiella* Clench & Pérez-Farfante, 1945. Vokes (1968) and Emerson & D'Attilio (1970) illustrated the radula of the type of *Murexiella, M. hidalgoi* Crosse, 1869, and Ponder (1972) illustrated the radula and operculum of the type of *Favartia, F. brevicula* Sowerby, 1834, and he determined that "*Murexiella* can be regarded, at best, as being only subgenerically distinct from *Favartia*." We follow Ponder (1972) in considering *Murexiella* as a subgenus of *Favartia*.

The following abbreviations for institutions and collections are used in the text: National Museum of Natural History, Smithsonian Institution (USNM); Santa Barbara Museum of Natural History (SBMNH); San Diego Natural History Museum (SDNHM); Shasky Collection (SC); Hertz Collection (HC); Myers Collection (MC).

Systematics

Muricidae Rafinesque, 1815

Muricopsinae Radwin & D'Attilio, 1971

Genus *Favartia* Jousseaume, 1880

Subgenus *Murexiella* Clench & Pérez Farfante, 1945

Favartia (*Murexiella*) ***lillouxi*** Myers & Hertz, sp. nov.

(Figures 1–4)

Description: Shell small, maximum size 13.8 × 8.4 mm, fusiform, spire elongate. Protoconch with 1½ white, bul-

[1] Mailing address: 3761 Mt. Augustus Ave., San Diego, California 92111, USA.

[2] Mailing address: 3883 Mt. Blackburn Ave., San Diego, California 92111, USA.

bous nuclear whorls somewhat oblique, tip immersed, buttressed on last half whorl. Teleoconch of five whorls, suture moderately impressed, six varices on body whorl, six on penultimate whorl. Leading edge of varix foliose, deeply excavated abaperturally. Aperture ovate, outer lip crenulate reflecting spiral cords, inner lip erect along entire length, smooth within, anal sulcus weakly defined. Siphonal canal moderately long, open to right, tubelike, sharply recurved, two-three well-preserved canal terminations on siphonal fasciole. Spiral sculpture of two cords on each of first four whorls, body whorl with five strong cords followed by gap and one strong cord on canal, bifid terminally. All cords, webbed between, terminating in open spines at varices; cords on first and second whorls with two spiral grooves along length, third, fourth and canal cords with one groove. Remnants of appressed scales on cords. Subadult uneroded specimens scaly with fine incised lines covering scales visible under magnification. Radula and operculum unknown, specimens dead collected. Color ochre to light brown.

Type locality: Off Pointe Taharaa, Tahiti, Society Islands (17°45.2′S, 149°30.4′W) in 11–22 meters.

Type material: All type material collected within a mile of the type locality (*fide* D. R. Shasky). Holotype: 12.5 mm × 8.7 mm (SBMNH 144184), off Pointe Taharaa, in 11–22 m, collected from 21–24 October 1996, leg. D. R. Shasky; Paratypes: A, 5.2 × 3.9 mm (USNM 880251), Papara, Tahiti, on coral in 0.6–1.5 m, 16 October 1996, leg. D. R. Shasky; B (broken specimen, spire missing), 7.8 mm width of body whorl (SDNHM 93557); C, 13.8 × 8.4 mm; D, 9.7 × 6.6 mm; E, 8.8 × 6.6 (broken canal); (B–E off Pointe Taharaa, collected in 11–22 m, from 21–24 October 1996, leg. D. R. Shasky & P. Lilloux (SC); F, 5.2 × 3.3 mm, same data as B–E (HC); G, 3.2 × 2.2 mm, Pointe Taharaa, in 11–22 m, 14–21 October 1996, leg. D. R. Shasky (SC); H, 4.4 × 2.7 mm, same data as G (MC); I, 11.8 mm × 7.3 mm, Pointe Taharaa, in 11–22 m, 21–24 October 1996, leg. D. R. Shasky & P. Lilloux (SC); J, 9.7 × 6.9 mm, in 15 m, Motu Martin, Tahiti, 14 October 1996, leg. D. R. Shasky (SC).

Other material studied: Two broken specimens off Motu Martin, Tahiti, in 15 m, 14 October 1996, leg. D. R. Shasky (SC).

Distribution: *Favartia* (*Murexiella*) ***lillouxi*** is known only from Tahiti, Society Islands.

Etymology: This species is named in honor of Patrick Lilloux of Mahina, Tahiti, a longtime friend and dive buddy of D. R. Shasky, who contributed several of the type specimens.

Discussion: This species closely resembles *Favartia* (*Murexiella*) *rosamiae* D'Attilio & Myers, 1985, but differs in the protoconch, number of varices, and spiral sculpture. The protoconch of *F.* (*M.*) ***lillouxi*** has 1½ bulbous whorls whereas *F.* (*M.*) *rosamiae* has 3¼ conical whorls. *Favartia* (*M.*) ***lillouxi*** has six varices on the body whorl and *F.* (*M.*) *rosamiae* has four. There are five spiral cords on the body whorl and one on the canal in *F.* (*M.*) ***lillouxi*** and six on the body whorl and two on the canal in *F.* (*M.*) *rosamiae.*

Favartia (*M.*) ***lillouxi*** is also similar to *F.* (*M.*) *voorwindi* Ponder, 1972, a species having a shell with a broader shoulder and shorter spire. *Favartia* (*M.*) ***lillouxi,*** with its higher spire, is light brown with straight spines whereas *F.* (*M.*) *voorwindi* has a white shell with recurved spines.

Favartia (*M.*) ***lillouxi*** does not closely resemble any other western Pacific species, and our examination of worldwide *Favartia* species revealed no close congeners.

Acknowledgments

The San Diego Natural History Museum made its collections in the Scientific Library and Marine Invertebrate Department available to us. David K. Mulliner of San Diego, California, did the photography and Emily H. Vokes of Tulane University, Louisiana, reviewed the manuscript. For this we thank them. We express our appreciation to Donald R. Shasky for giving us the opportunity to describe this new *Favartia* species and for the donation of type material.

Literature Cited

Clench, W. J. & I. J. Pérez-Farfante, 1945. The genus *Murex* in the Western Atlantic. Johnsonia 1(17):1–58.

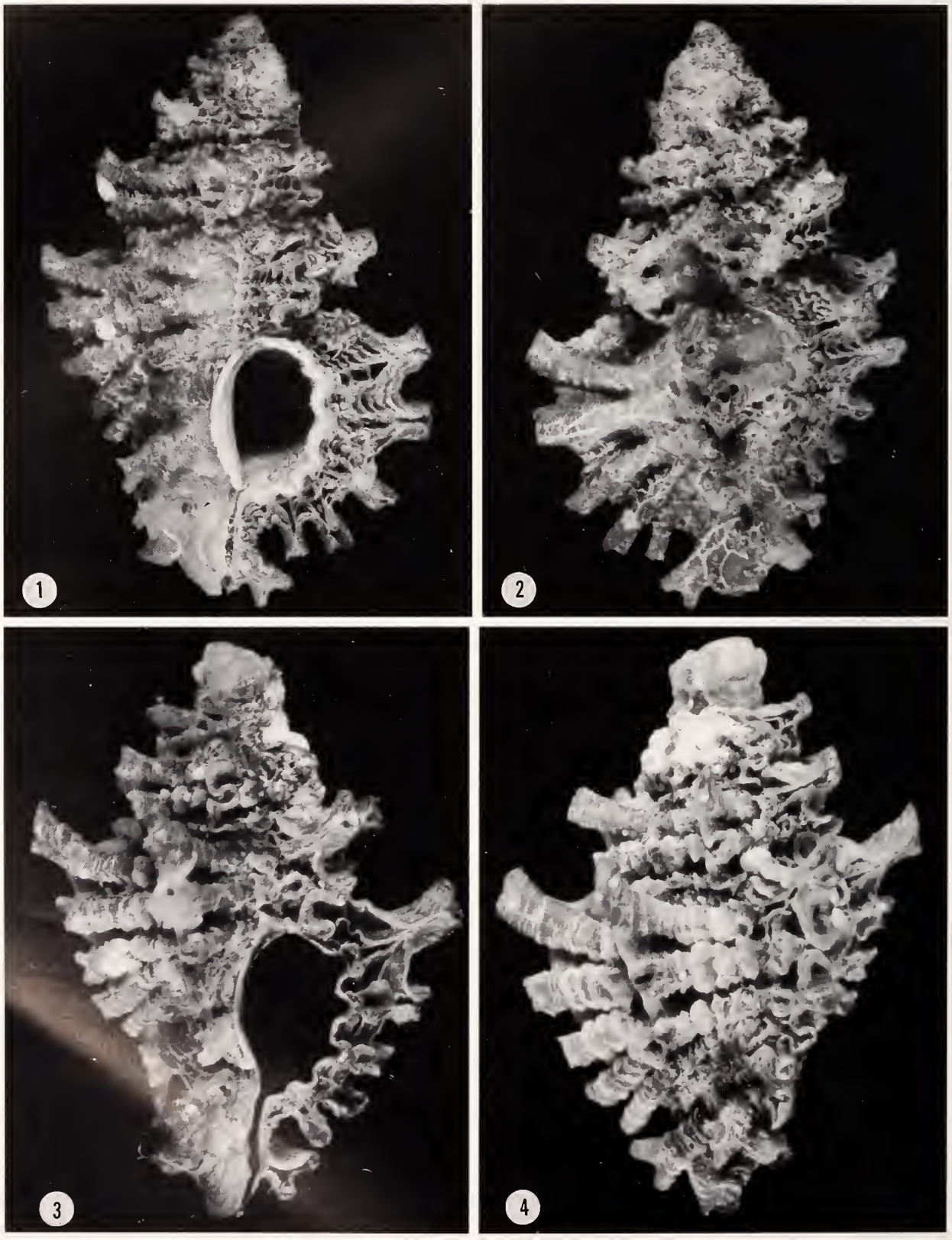
Crosse, H., 1869. Diagnoses molluscorum novorum, Journal de Conchyliologie 17:408–410.

D'Attilio, A. & B. W. Myers, 1985. Two new species of *Fa-*

→

Explanation of Figures 1 to 4

Figures 1, 2. *Favartia* (*Murexiella*) ***lillouxi*** Myers & Hertz, sp. nov. Holotype (SBMNH 144184), 12.5 × 8.7 mm. Off Pointe Taharaa, Tahiti, Society Islands, in 11–22 m. Leg. D. R. Shasky, 21–24 October 1996. (1) apertural view (2) dorsal view. Figures 3, 4. *Favartia* (*Murexiella*) ***lillouxi*** Myers & Hertz, sp. nov. Paratype A, 5.2 × 3.9 mm (USNM 880251). Papara, Tahiti, Society Islands, in 0.6–1.5 m on coral. Leg. D. R. Shasky, 16 October 1996. (3) apertural view (4) dorsal view. This specimen illustrates the protoconch and the foliaceous nature of the sculpture.


1
2
3
4

vartia from the West Pacific Ocean (Gastropoda: Muricidae). The Nautilus 99(2–3):58–61.

EMERSON, W. K. & A. D'ATTILIO, 1970. Three new species of muricacean gastropods from the Eastern Pacific. The Veliger 12(3):270–274.

JOUSSEAUME, F., 1880. Division méthodique de la Famille des Purpuridés. Le Naturaliste 42:335–356.

PONDER, W., 1972. Notes on some Australian genera and species of the family Muricidae (Neogastropoda). Journal of the Malacological Society of Australia 2(3):215–248.

SOWERBY, G. B. (second of name), 1834. Conchological Illustrations (*Murex*). London, pls. 58–67.

VOKES, E. H., 1968. Cenozoic Muricidae of the western Atlantic region Part IV—*Hexaplex* and *Murexiella*. Tulane Studies in Geology 6(3):85–126.

High Performance Thin Layer Chromatography Determination of Carbohydrates in the Hemolymph and Digestive Gland of *Lymnaea elodes* (Gastropoda: Lymnaeidae)

Daniel J. Cline*, Bernard Fried** and Joseph Sherma*
Departments of *Chemistry and **Biology, Lafayette College, Easton, Pennsylvania 18042, USA

Introduction

Recent studies in our laboratory have been concerned with high performance thin layer chromatography (HPTLC) analyses of carbohydrates in the hemolymph and digestive gland-gonad (DGG) complex of medically important planorbid snails. Thus, Anderton et al. (1993) reported quantitative values for glucose and trehalose in *Biomphalaria glabrata* (Say, 1818) snails maintained on various diets, i.e., leaf lettuce, Tetramin®, and hen's egg yolk. Perez et al. (1994) studied the effects of larval trematode parasitism by *Echinostoma caproni* Richard; 1964, on sugars in *B. glabrata* and found that parasitism significantly reduced the amounts of glucose and trehalose in the hemolymph and DGGs of infected snails. Conaway et al. (1995) provided quantitative data on glucose and trehalose in several strains of *Helisoma trivolvis* (Say, 1816) snails with and without infection by larval echinostomes. Umesh et al. (1996) used HPTLC to analyze the effects of restricted diets on glucose in the hemolymph and DGG of *B. glabrata* and *H. trivolvis*. Their results showed that glucose levels were not significantly altered in snails maintained on the restricted diets described in that study.

Less information is available on the quantitative analysis of carbohydrates in lymnaeid than in planorbid snails. Lymnaeid snails play a less important role in medical malacology than do the planorbids, and this accounts in part for the relative paucity of quantitative biochemical data on the effects of diet and larval trematode parasitism on lymnaeids. A recent study on infection of *Lymnaea elodes* (Say, 1821) in the USA with a species of *Echinostoma revolutum* (Froelich, 1802) that causes intestinal helminthiasis in wildlife and is a potential foodborne pathogen to man has been reported by Sorensen et al. (1997). Because of that report, there is renewed interest in examining various aspects of the biology and chemistry of this snail. Moreover, *L. elodes* is easy to maintain in the laboratory, attains a length of up to 3 cm within 3 months, and is a convenient experimental model for biochemical studies. A previous study on this model used HPTLC to determine neutral lipids and phospholipids in whole snail bodies (Frazer et al., 1997). The purpose of the present study was to examine by HPTLC the identity and concentrations of carbohydrates in the hemolymph and digestive gland of *L. elodes* maintained on a leaf lettuce diet.

Materials and Methods

Sugar standards were purchased from Sigma (St. Louis, Missouri, USA). Standard solutions of each sugar were prepared at concentrations of 100 ng/μL (standard solution A) and 1.00 μg/μL (standard solution B) in 70% ethanol.

Stock cultures of *L. elodes* snails were maintained at 22°C in aerated aquaria containing artificial spring water (ASW) as described in Frazer et al. (1997). Snails were fed *ad libitum* on boiled leaf lettuce. Most snails were used for analyses immediately after removal from the cultures. Some snails were maintained in ASW without food for either 4 or 12 hr prior to use for analyses (referred to below as 4-hr starved or 12-hr starved snails).

Analyses were done on pooled samples of hemolymph and digestive glands (DGs) (three snails/pool) from snails ranging between 24 and 30 mm in shell length. For hemolymph analysis, snails were blotted dry with paper towels, gently crushed, and the hemolymph from three snails collected in a 1.5 mL microcentrifuge tube. The sample was centrifuged for 3 min at 8000 g to separate the plasma from the hemocytes. One hundred μL of plasma, measured with a 100 μL Drummond (Broomall, Pennsylvania, USA) digital microdispenser, was separated from the amoebocyte pellet and placed in a new microcentrifuge tube with 500 μL of 70% ethanol. The sample was centrifuged for 5 min at 8000 g. The supernatant was combined with two washings of the pellet (100 μL of 70% ethanol for each washing) in a 2 mL vial. The sample was evaporated to dryness in a water bath (50–60°C) under a gentle stream of air and then reconstituted in 200 μL of 70% ethanol.

Snail DGs were separated from the bodies with forceps, taking care to remove and discard the gonads and digestive tract. The wet weight of the three DGs in each pool was determined (about 150 mg) before the tissues were homogenized with 500 μL of 70% ethanol in a 7